

VII.

SUGGESTIONS concerning the PROFESSIONAL STUDIES
of FOREST OFFICERS ON FURLOUGH in EUROPE.

Object and
limits of these
remarks.

THE object of the following remarks is to offer suggestions for the consideration of Indian forest officers on leave in Europe, who may desire to make themselves acquainted with the management of public and private woodlands in this country and on the continent. In February 1867 I prepared a memorandum with the same object in view, and that paper is referred to in some of the preceding Reports. In drawing up the present remarks, which are now intended to replace the original memorandum, I have been guided by the experience gained by forest officers who have, in accordance with the arrangements made in 1866 and 1867, endeavoured to complete their professional studies during their furlough in Europe.

The present remarks will, with few exceptions, be limited to those forest districts with which I am personally acquainted, and I desire to state at the outset that I am not at present in a position to exhaust the subject, for of continental countries I have sufficient personal acquaintance with forest management in France and Germany only, and in a few districts of Italy and Austria; I must therefore leave it to others to indicate those points to which forest officers should devote special attention who may desire to go further. The organisation of the Forest Department in Russia, the system of timber transport in Sweden and Norway, the great differences which existed formerly, and which partly still exist, in the forest legislation of the different cantons of Switzerland, and the effect which this state of things has had upon the condition, not of the woodlands only, but also of the fields and pastures in the different valleys of the Swiss Alps, the gradual denudation of many districts of Spain, the influence of this denudation in diminishing the fertility and the wealth of the country, and the attempts which have been made to counteract these effects, all these will form instructive subjects for the study of such forest officers as may have an opportunity of visiting those countries and learning their language. In Turkey, too, the attempts made some time ago, under the guidance of a number of able French forest officers, to establish a regular forest administration, may be found suggestive in many respects to Indian foresters. Nor is the field of useful studies for Indian forest officers confined

to Europe, or to those countries where the management of natural woodlands and plantations is an old established and recognised profession. The gigantic lumber trade of Canada, the extraction of resin in Florida and Carolina, the effects which forest clearings on the largest scale have had in several of the United States,* all this would afford a vast amount of instructive information to those who are entrusted with the working and the preservation of our forest resources in India. The study of the conditions under which the *Wellingtonia* of California, and the *Eucalyptus* of Tasmania, attain dimensions far exceeding anything known in the most luxuriant of our Indian forests would be a task, which an Indian forester, who has the needful knowledge of climate and the growth of trees might undertake with great advantage. Arboriculture in Japan also, will, I feel convinced, eventually prove a source to us of much practically useful information.

The present arrangements, which facilitate the professional studies in Europe of forest officers on leave, were made in 1866. *Capt. Seaton*, the present Conservator of Forests in Burma, and *Capt. W. Stenhouse*, at present officiating in Oudh, were the first to avail themselves of them. With great perseverance and industry these officers went through a regular course of studies in the mixed beech and oak forests of Villers Cotterets in France, at Nancy, and in the spruce and silver fir forests of the Western Vosges near Remiremont. They derived great benefit from what they learnt, and their example has been followed by a number of forest officers from different provinces of India. Some of these have, I believe, profited much, and the reports which precede these remarks afford ample proof of the great importance of such studies, when undertaken in the right spirit, and in a proper methodical manner. Others may have returned to India dissatisfied with the result of their professional studies at home; if so, the reason probably was that they went to work in a *dilettanti* sort of fashion, and that instead of going through the labour of mastering the details of forestry, they imagined that their experience in India entitled them at once to come to conclusions of a general and sweeping nature after a hurried journey through the country. On this account I am anxious at the outset to state my opinion in unmistakable terms that those only should avail themselves of the facilities now offered for their professional studies, who are able and willing to devote sufficient time to them.

Existing
arrangements,
how utilized.

* G. P. Marsh. *Man and Nature*. London, 1864, pp. 51, 300.
(8355.)

Studies on the continent demand some knowledge of the language.

I will now briefly indicate those points to which the attention of an Indian forest officer on furlough should be specially directed. The first point to be decided seems to be, whether he should attempt a course of studies on the continent, or whether he had better confine his attention to what may be learnt in this country. Some knowledge of either French or German is an indispensable condition of successful studies on the continent, and familiarity with the language will enable him to get through the work in much less time, and in a more satisfactory manner. Should any one desire to study on the continent without a sufficient previous knowledge of the language, then my advice would be, in the first instance, to settle down at a quiet place to learn the language; and after having made some progress, to seek the acquaintance of any forest officers who may reside in the vicinity, so as to become acquainted with the technical terms and expressions used in the profession. For the purpose of learning the language there are numerous places to choose from; should any one desire a hint in this respect, I may state that in France, Nancy for the north, or Aix en Provence for the south, would probably be found to answer; and that in Germany, Hanover, Gottingen, Eisenach, Bumberg, and Stuttgart may be named, but that there are many other places equally suitable.

Professional studies in Great Britain.

To those who have time to study both in this country and on the continent, my advice is, first to go abroad, and then to take up forestry in England and Scotland. This I am inclined to think will be found a good arrangement. As, however, in most cases circumstances may not permit a course of studies abroad, I will, in the first instance, endeavour briefly to indicate the subjects to which attention should be directed in this country. In the reports which precede these remarks the Crown forests and some of the largest and most instructive private wooded estates are mentioned, but there are many others besides, and forest officers on furlough will find ample opportunities in most counties to acquire an abundance of useful information regarding arboriculture. A general book on forestry is the well known work *The Forester*, by James Brown, 4th edition, 1871. *John Grigor's Arboriculture* will also be found useful. Instructive papers on special subjects will be found in the *Transactions of the Highland and Agricultural Society of Scotland*, and of the *Scottish Arboricultural Society*. The *Gardeners' Chronicle and Agricultural Gazette* also has occasional articles on the subject of forestry. But the best school is constant personal intercourse in their forests and woodlands with the forest officers of the Crown forests and

with experienced wood managers and foresters on private estates.

I will commence by a few remarks on coppice woods, the management of which is more simple than that of high timber forests. I would draw special attention to the laying down and treatment of Osier beds, which may be seen in great perfection along the Thames and elsewhere. Such coppice of willows, which is cut over annually or every second or third year, yields a high rent on good soil, the material being used by the basket maker and cooper. In India we have nothing exactly like it at present, but I am inclined to think that similar short rotation coppice woods of willows or other fast growing trees might be made to yield a good return. Oak coppice for bark, the stripping and drying of bark for tanning, mixed coppice of hazel, lime, and other trees, coppice with standards of oak may be studied in most counties, and it is not necessary to mention particular localities. The main points to which attention should be directed are, the length of rotation, which will be found to vary within wide limits, according to climate, soil, kinds of trees and the requirements of the market, the quantity and value per acre of the crop at the fall, the intermediate thinnings, the number of standards, if any, per acre, and their share in increasing the value of the crop. In some places the yield of the coppice is considerably increased by planting larch and other coniferous trees with it. The coppice woods without standards for the growth of hop poles in Surrey, Sussex, and particularly in Kent, merit special and careful study. In 1866 I had the privilege of visiting the woods of Sir Edward C. Dering, of Surrenden, near Ashford, and I must say, I have seen nothing anywhere in Europe to be compared to them. The ground is carefully trenched; ash and Spanish chestnut are planted close together, often mixed with larch, and the results, both as regards rapidity of growth, length of poles, and the money returns realised, are very remarkable. It is instructive to compare these carefully tended and highly productive woods with the old natural coppice, which often yields a very small return. Sir Edward has been good enough to state that any of the forest officers from India who may wish to inspect his plantations are at liberty to do so, if furnished with the needful introductions from the India Office.

Oak and mixed coppice with a large number of oak standards is a form of forest not uncommon in the south of England, similar in many respects to the "*Taillis sous futaie*," generally found on private estates in the north and centre of France. The coppice keeps the ground under cover, draws up the younger standards, and yields an additional

Coppice with standards.

return. The part which is here performed by the coppice will remind Indian foresters of the beneficial effects of Bamboo underwood under Teak, or of Tamarisk wood under the Babul and Euphrates Poplar in Sindh. In one of the preceding reports a sketch of the self-sown Oak woods of Sussex is given. The timber is here the main crop, but it is raised with the aid of the underwood.

Timber forests
with natural
reproduction.

Considerable extents of natural high forest, mainly maintained by self-sown seedlings, are to be found in various parts of the country. The natural forests of Scotch fir in the Highlands have been described by Captain Walker, and the beech of Buckinghamshire is mentioned in Mr. Webber's report. The management of these beech woods is exceedingly interesting; they are uniformly dense woods, the trees not full grown; where I have seen them they appeared to be between 60 and 80 years old, but sufficiently mature to shed seed. There is a sprinkling of ash, whose light green foliage overtops the more yellowish green heads of the beeches. The cuttings, which go through the forest in a regular rotation, merely consist in thinning out a small proportion of the larger trees. Small blanks are thus formed, which are filled up readily by self-sown seedlings. The system is exceedingly conservative, the soil improving steadily by the mass of vegetable mould formed by the decaying beech leaves, and it is probable that if there were a sufficient demand for this description of wood, some of these forests might be made to yield a larger annual crop than they are said to yield at present. Excellent Scotch fir woods of considerable extent, originally planted, but now maintained mainly by natural reproduction, may be seen in Windsor Forest, near Swinley and Sandhurst, and generally it may be said that the maintenance of timber forest by self-sown seedlings of oak, birch, beech, Scotch fir, and even of larch and spruce, is understood and utilised in many places, so that there is no lack of opportunities in acquiring useful information on this branch of forestry, which is particularly important for Indian foresters.

Plantations.

Plantations, however, are, *par excellence*, the strong point of arboriculture in Great Britain. As far as my experience goes, there is no country in Europe where plantations on a large scale are made at a less cost per acre (considering the rate of labour) or with more uniform success. The continuously moist climate, without any long-continued droughts is a great help in this respect, but the skill of nurserymen and foresters is, I believe, the principal element of success. In order to understand the selection and treatment of seeds and the management of nurseries, it will be well to spend some time at the great nursery of the Lawson Seed Company,

near Edinburgh, or any other large forest nursery. Plantations are often made by contract, and I have seen extensive and very successful plantations in the North which had been raised in that manner; a study of the conditions usual in such contracts will be found instructive. For the planting of oak with the aid of nurses of coniferous trees, no better school could be recommended than Windsor Park, the New Forest, and Dean Forest. The procedure in each of these has its peculiar points, which must be studied on the spot. For larch and Scotch fir plantations, Strathspey, the estates of the Duke of Athol and the Earl of Mansfield, in Perthshire,* are particularly instructive, but forest officers should not confine their studies to these localities. Indian foresters will naturally desire to inform themselves regarding the cost of plantations, as compared with the value of the thinnings and the final crop per acre, and on many estates these figures are readily available, but it may not be out of place to guard against publishing such information, or inserting it in an official report without due authority from the proprietor or his agent.

The formation and management of plantations comprises a wide range of subjects; it will be sufficient to mention a few to which attention should specially be directed. The different descriptions of fences can be studied better in this country than I believe anywhere else. The great mass of the public forests in India will probably remain unfenced, just as with few exceptions, the large public and most of the private forests in France and Germany are not surrounded with fences, but in certain special cases fencing will be found indispensable in India. Their management.

The comparative merits of pit planting and notch planting, L and T slit under different circumstances, the use of the spade or hand iron † in different soils and with different kinds of trees; these are matters the study of which will be of direct practical use in India. Early and oft repeated thinnings are to a certain extent a peculiar feature of Scotch and English forestry, and much may be learnt in this respect by Indian foresters. I am well aware that under the powerful light and sun of Indian latitudes (10° — 34°) forests and plantations require to be kept more close and compact, and the ground more completely covered than is desirable in lat. 55° , but then there is hardly any operation of forestry, which can with advantage be mechanically copied in another

* It may be useful here to state that in Scotland the best seasons for studying planting work are, in Perthshire, early spring, from February to April; and in Strathspey, April to July.

† A remarkable kind of spade, with a triangular blade which ends in a narrow prong 16 in. long, is used in the New Forest for planting hardwood and coniferous trees.

country, or even in another county. The object of studies like those here recommended is not to acquire empirical knowledge of planting and thinning as done in Perthshire or Gloucestershire, but to understand the principles which guide foresters in the successful management of their plantations.

Working of
the forest and
forest rights.

Much may be learnt in the matter of timber sales and working of forests. Notices and conditions of sales should be studied and information collected regarding the prices realised in different localities and under different circumstances. The valuation of standing timber for sale and for other purposes will afford much instruction. The construction and use of portable saw mills and of water power saw mills of simple construction can nowhere be studied more advantageously than in Strathspey and elsewhere in Scotland.

Regarding the important subject of forest rights it will suffice to refer to *Capt. Walker's* account of the history of the New Forest and Dean Forest, and to add that those who may desire to study the legal bearings of this subject, should consult a small book by Wingrove Cooke, "*The Acts for facilitating the Inclosure of Commons, with a Treatise on the Law of Rights of Commons.* London, 1864." An old work by John Manwood, "*A Treatise of the Laws of the Forest.* London, 1665," contains much information concerning the history of forest rights. The *Register of the Decisions of the Commissioners for the Settlement of Claims upon and over the New Forest, appointed in 1854*, has also been printed under the authority of the Treasury in a small octavo volume, which gives a detailed account of every forest right allowed in that forest.

Most branches
of the subject
may be studied
in this country.

The preceding remarks will show that there is hardly any branch of forestry which cannot to a certain extent be studied in this country. There is, however, this difference that in France or Germany the public, that is, the state or communal forests, and those large private forest properties which are managed on the same principles, are much more extensive, and form large compact masses, which are managed by great and well organised departments, the officers of which have all received a special professional education, practically and theoretically. The great branches of forest business, the settlement of forest rights, the protection of the forests, their working and regeneration by natural or artificial means, and their improvement and extension, all this has during a long series of years gradually come to be arranged in a methodical and systematic manner in the public forests. Complete financial results of their management are periodically made public, and are constantly

discussed and criticised by professional foresters. Thus it is easier to acquire correct general notions and principles by studying the management of the large continental forests, and on this account I have recommended to those who can afford it to commence by going abroad, because their studies abroad will enable them to utilise their time better, when completing their studies in this country.

There are numerous other subjects connected with forestry to which forest officers on furlough in this country may with great advantage direct their attention. Foremost stands the introduction of exotic trees. In this respect Great Britain has always taken the lead. Indian foresters will naturally in the first instance, direct their attention to the cultivation of the Deodar and other Himalayan conifers. In that respect the experience gained in Windsor Park, at Dropmore, Ealing Park, and Kew, is exceedingly instructive, but the growth of the Deodar may be studied in almost any park in England and the south of Scotland. The practical lesson which Indian foresters will probably draw from the study of this subject will most likely be, that such trees as the cedar of Lebanon, the Deodar, the Douglas pine, succeed wonderfully well as ornamental trees in this climate, but that their value as forest trees for the production of timber in this country is doubtful. Studies of this kind will serve to make them cautious in acting upon the numerous well meant suggestions which are offered on all sides for the introduction of foreign trees into India, and for the cultivation of Indian trees beyond the range of their natural distribution. On the other hand the larch itself is a striking example of the successful introduction of an exotic forest tree. Indigenous in the clear and dry atmosphere of the Alpine regions of Central Europe, and nowhere cultivated on a large scale in this country before the commencement of the present century, it is now so completely naturalised in Scotland, that it is second in importance only to the Scotch fir among coniferous forest trees. And yet, though in several places the larch propagates itself readily by self-sown seedlings, it does not, save under very favourable circumstances, remain sound and healthy until it attains to mature age. In India foremost among introduced forest trees stand the Eucalyptus and Acacias from Australia, some species of which have changed the aspect of certain parts of the Nilgherries, and there seems every prospect of Cinchona coppice woods becoming a most important description of Forest on the higher mountains of India.

Introduction of exotic forest trees.

The durability of different descriptions of timber under different circumstances is another subject, regarding which useful information may be collected in this country, in so

far as it will suggest simple methods of ascertaining the relative durability of different kinds in India. We are in darkness regarding the comparative durability of most of our Indian timbers, mainly because it appears a formidable undertaking to watch them sufficiently long. But there is no doubt in England regarding the comparative durability of split and sawn oak, larch, or Scotch fir as posts, palings, or pitprops; it is generally fairly well known how long a wood of a certain kind and age will last under certain circumstances, and yet most of this information has been acquired and confirmed merely by putting together the ordinary every day experience on this subject.

Navy dock-
yards.

The storing and seasoning of timber, its conversion at sawpits and sawmills, the different descriptions of scantling used for shipbuilding, may be studied at the navy dockyards with the requisite permission of the Lords of the Admiralty. Chatham and Pembroke are, I understand, the most instructive navy dockyards in this respect. The impregnation of railway sleepers and other timbers with creosote and other antiseptic substances, the manufacture of charcoal, and the comparative value of woods as fuel are likewise subjects which merit the attention of forest officers on furlough.

Surveying.
Natural
sciences.

Those who may desire to learn surveying and land measuring, or any branch of the natural sciences during their furlough at home will find no difficulty in making the needful arrangements for that purpose, and I need say nothing more about it. It may, however, be well to mention one public institution which should be visited and utilised by all. I mean the Gardens and the Museum of Economic Botany at Kew. These institutions have no equal anywhere as regards completeness and good management, and their importance to Indian forest officers cannot be overrated. Dr. Hooker, the director of these institutions, has authorised me to state that he will be glad to see and to assist with his advice any forest officers who may desire to study botany or other branches of natural history during their furlough at home.

Studies in
France.

The general course of studies to be followed in France by Indian forest officers on leave is sketched out in the following regulations which were drawn up by me in 1866, in consultation with a number of French forest officers, and were sanctioned in January 1867 by the then Director-general of Forests:—

Règlement concernant les études des agents forestiers Anglais de l'Inde, en congé durant leur séjour en France.

Art. 1^{er}. Les agents forestiers anglais, auxquels le Ministre de Sa Majesté Britannique de l'Inde permettra de compléter leur éducation forestière en France, seront accrédités auprès de M^r le Directeur Général

des Forêts. Ils se présenteront à la Direction générale des Forêts à Paris et seront munis d'une lettre d'introduction qui fera connaître la durée probable de leur séjour en France. Selon la saison et la durée de leur séjour en France, les localités différentes pourront leur être assignées pour y étudier le régime forestier français.

Art. 2. Le but principal de leur mission sera d'étudier la théorie générale de l'économie forestière et de suivre l'application de cette théorie dans les forêts françaises. Mais comme les dates d'arrivée et de départ des agents forestiers de l'Inde, en congé, seront variables, il n'est pas possible de les astreindre, pour l'emploi de leur temps, à une règle uniforme et qui soit applicable à tous.

Art. 3. En principe, il convient que les agents en mission consacrent la plus grande partie de leur temps à étudier la pratique du service forestier, et ne viennent à l'école, pour y suivre les cours les plus importants, qu'après s'être bien familiarisés avec la technologie forestière et avoir acquis, sur le terrain des forêts une connaissance suffisante des principales opérations forestières et des travaux d'amélioration de toute sorte qui s'y exécutent.

Art. 4. Dans ce but, ces agents seront envoyés successivement dans des résidences forestières offrant des différences bien marquées sous le rapport du climate, du terrain et des essences forestières qui y sont cultivées; soit, par exemple, à Villers-Cotterêts, pour y étudier les futaies mélangées de hêtre et de chêne; dans les Vosges, pour les sapinières.

Art. 5. Pendant le temps (un mois au moins) qu'ils auront à passer dans chacune de ces résidences, l'emploi de leur temps sera réglé de la manière suivante.

Dans chaque localité, ils feront une étude spéciale et complète d'une série ou de deux séries de futaie, qui leur seront désignées par l'agent chargé de les diriger. A cet effet, ils prendront une copie du plan et feront un extrait du procès-verbal d'aménagement de la série à étudier. Puis avec ces documents, ils visiteront et décriront chaque parcelle et ils se rendront un compte exact de toutes les opérations effectuées conformément aux prescriptions du procès-verbal d'aménagement. Ils apprécieront le mérite de ces opérations et ils rédigeront un mémoire, en anglais, dans lequel ils consigneront les principales données du procès-verbal d'aménagement et le résultat de leurs propres observations.

Ils feront un travail analogue sur l'aménagement d'une série de taillis sous futaie.

Chaque fois qu'ils en auront l'occasion, ils accompagneront les agents forestiers dans leurs opérations de martelage, d'estimation et de récolement; ils visiteront les exploitations et, spécialement, les coupes d'éclaircie et de nettoisement; ils feront une étude particulière de tous les travaux d'amélioration à exécuter dans les forêts, tels que semis, plantations, préparation du terrain, création et entretien de pépinières, &c.

Enfin, si la chose est possible, ils assisteront à des ventes de bois sur pied et de produits façonnés, et, à ce propos, ils étudieront les dispositions principales du cahier des charges générales et du cahier des clauses spéciales relatives aux exploitations et à la vente des coupes.

Art. 6. Les agents anglais tiendront un livre journal dans lequel ils feront connaître l'emploi de leur temps et où ils consigneront les observations de toute sorte qu'ils auront recueillies, sur les différentes parties du service forestier, dans les localités qu'ils auront visitées.

Les agents forestiers français leur délivreront un certificat constatant la part qu'ils auront prise aux travaux qui leur seront prescrits.

Art. 7. Avant de quitter la France, ils se présenteront à la Direction générale des Forêts à Paris, où les certificats qui leur auront été délivrés seront contresignés par M. le Directeur général des Forêts.

Art. 8. Il est recommandé aux agents anglais de se procurer les livres ci-après désignés et de les étudier pendant leur séjour en France :

- 1°. Cours élémentaire de culture des bois, par M.M. Lorenitz et Parade;
- 2°. Cours d'aménagement des forêts, par M. Nanquette;
- 3°. Cours d'exploitation, débit et estimation des bois, par M. Nanquette;
- 4°. Flore forestière, par M. Mathieu;
- 5°. Manuel du garde forestier, par M. Bouquet de la Grye;
- 6°. Les codes de la législation forestière, par M. Jacquot.

Haguénau, le 6 Janvier 1867,

D. BRANDIS.

Approuvé :
Le Directeur général des Forêts,
J. LAYDEKER.

Concerning the books on forestry recommended in the last paragraph, I desire to state that M. Bagueris, one of the Professors at the Nancy Forest School, has just published an excellent small handbook, entitled *Manuel de Sylviculture*, which may be substituted for the books mentioned under 1° and 5°. This manual is principally intended for the use of subordinate forest officers, and I understand that the French forest administration has purchased a large number of copies for distribution. It will be found to contain nearly all that is wanted to guide Indian forest officers in studying in France this particular branch of the subject. By way of a general introduction I would recommend the perusal of an essay written by Mr. Sykes Gamble on the State Forest schools of France. (*Transactions of the Highland and Agricultural Society of Scotland*, 1872.) And in order to acquire some familiarity with the current literature of forestry, I would recommend to take in for one year the Monthly French Forest Magazine (*"Revue des Eaux et Forêts"*). With it is distributed to subscribers the *Annuaire*, containing the forest statistics for the year, the classified list of all forest divisions and districts, and a complete list of all public forest officers. A small popular work by Clavé (*Études sur l'économie Forestière*, Paris, 1862), will also be found useful by way of introduction. With the assistance of these publications any one familiar with the language will soon make himself at home in the terminology of the profession, and in those general notions which it is well to possess before entering upon a regular intercourse on professional matters with French forest officers. I would not recommend any one to commence his regular studies in France, or to present his official letters of introduction, unless he be sufficiently acquainted with the language.

Forestry in France has certain marked peculiarities and strong points which it may be well briefly here to indicate. *Natural reproduction* is relied upon to a much greater ex-

tent than is the case either in this country or in north and middle Germany; and upon the whole it must be said that the young and middle aged forests which have grown up under the systematic management of the last 60 or 80 years are in a very satisfactory state. I am not now speaking of coppice woods and coppice under standards where natural regeneration is easy, and follows as a matter of course, but of the high timber forests, both of coniferous and leaf-bearing trees. The moist, and upon the whole mild, climate of most parts of the country is a great help in this respect, but much is due to care and good management.

Another point is, that the woodlands of France are composed of a much greater variety of trees than those of England or Germany. The different kinds of oak are the most important forest trees in France, and as the requirements of the two principal species of oak are similar in many respects to those of the teak tree, the treatment of the oak forests in France deserves careful study. I would draw special attention to the pure oak forests (of *Quercus-pedunculata*) on the deep alluvial soil along the Loire, Adour, and other rivers of western France, and the mixed oak (chiefly *Quercus sessiliflora*), beech, and hornbeam forests which are found in most parts of central France. A small pamphlet by Bagneris and Broillard (*Etude sur la production du Chêne*, Paris, 1870) will be useful as a guide. The pruning of the oak standards with coppice underneath is done with great skill and on a large scale in many private woods of central France, and Indian foresters will do well to make themselves acquainted with the experience of those who are in favour of extensive pruning, and the views of those foresters who desire to restrict it to the removal of dead branches and of side shoots of stems suddenly placed free. Oak coppice for the yield of bark of the two species mentioned, and of *Quercus Tauzin* in the West, of *Quercus Ilex* and of *Quercus pubescens*, (the southern variety of *Quercus sessiliflora*), in the south of France, as well as the small scrub coppice of *Quercus coccifera*, the kermes oak, are all worth studying. I strongly recommend the management of coppice for bark under different circumstances, not in France only, to the careful study of Indian forest officers, for there seems little doubt that the best mode of treating *Cinchona* plantations will eventually be as coppice woods. The cork oak forests of the *Provence* will afford another subject full of instructive information, and I desire to draw special attention to numerous well managed private estates between Hyeres and Draguignan, in the granite hills of the Maures, where the cork oak is grown mixed with *Pinus halepensis* and *P. Pinaster (maritima)*. The attempts made to protect these forests against the fires of the hot and dry

Great variety
of forest trees.

summer months will be found to suggest similar measures for some of the Indian forests.* Of coniferous trees I will name the silver fir of the Vosges and of some parts of the Pyrenees, particularly in the *Département de l'Aude*, South of Carcassone, the larch forests of the Alpine districts, the forests of *Pinus Pinaster (maritima)*, of southern and western France, and those of *Pinus Laricio* in Corsica. The arborescent vegetation of that island presents a marked succession of forest zones, according to elevation, instructive in many respects to the Indian forester. Above the vast extents of *Mâki* (thick and dense brushwoods of *Phillyrea*, *Pistacia*, and other evergreen shrubs) which occupy the hilly land along the coast, are found, principally in sheltered and moist valleys, high timber forests of *Pinus Pinaster* and *Quercus Ilex*, and vast orchards of the sweet chestnut (*Castanea vesca*).[†] At a somewhat higher elevation commences the region of the Corsican pine, forming extensive forests, pure below, and mixed near its upper limit with the beech and silver fir, which form the last and highest belt of arborescent vegetation in the mountains of Corsica. *Mathieu's French Forest Flora* will be found an excellent guide to those who desire to become familiar with the trees and shrubs of the different parts of France, and as an additional help I will mention *Le Maout et Decaisne Flore des Jardins et des Champs*, Paris, 1855. Two of the coniferous trees are important on account of the resin which they yield. The extraction of resin should be studied either in the *Pinus Laricio* forests of Corsica, or in those of *Pinus Pinaster* in the *Départements des Landes* and *de la Gironde*.

Planting of
the Dunes.

Though in France the regeneration of existing forests is as a rule effected by self-sown seedlings or coppice shoots, natural reproduction is aided whenever necessary by planting and sowing, and plantations on a most extensive scale have been made and are in course of progress in order to clothe shifting sands or barren hills with forest. I do not know of any more instructive case of planting on a large scale than the forests of *Pinus Pinaster*, which now cover, with few breaks, the Dunes, on the coast of the Atlantic, between Bayonne and the mouth of the Gironde, a length of nearly 150, and a breadth of from two to six miles. The destructive progress of the shifting white sands of these Dunes inland is well known; fields, villages, and churches were covered by them, and all attempts to fix and to clothe them permanently with vegetation remained fruitless until 1787, when Brémontier, an engineer, succeeded in devising

* An excellent book to be consulted on the Forests of the Provence is, Charles de Ribbè, *La Provence au point de vue des Bois, des Torrents et des Inondations*.

means to protect the sowings against the drifting sand. The method must be studied on the spot, and no forester from India who has the privilege of completing his professional studies in France should neglect the opportunity of seeing this splendid work of arboriculture. Apart from the Dunes, a visit to the country about Dax and Mont-de-Marsan will prove instructive in many respects. The vast communal lands of the *Département des Landes*, formerly nothing but poor grazing grounds, swampy and uninhabitable during great part of the year, and to a great extent impassable, except on stilts, have now been made productive by draining and extensive sowings of the *Pinus Pinaster*. Then there is the collection of resin, the manufacture from it of oil of turpentine and other products, and near Dax, the well-stocked forests of *Quercus pedunculata* on the rich alluvial soil along the Adour river.

Much has of late years been done for the planting of barren mountain sides in the Alps, the Pyrenees, the Cévennes, the Auvergne, and other mountains of Central France. The object of these plantations has been twofold; one was to improve the productiveness of these mountain lands, the other object was to prevent the formation of torrents and ravines, to fix the loose soil on steep slopes, and thus gradually to diminish the mass of sand and stones which otherwise is carried down annually into the valleys, causing the wholesale destruction of fields and pastures. By clothing barren hill-sides with wood, both the superficial drainage of the country, and the infiltration and underground drainage are better regulated, and hopes, which seem well grounded, are entertained that these plantations will not only prevent the further deterioration of pastures and other lands on the slopes and in the valleys, but will eventually, to a certain extent, diminish the damage done by inundations, which have always been exceedingly destructive in the basins of the Loire and Rhone. These objects could not have been attained had the forest administration limited its operations to lands at the disposal of the State; legislation therefore became necessary, to enable them to operate where needful, in the same manner on communal and private lands. This led to the passing of two important enactments, the *Loi sur le reboisement des montagnes*, of July 1860, and the *Loi sur le gazonnement des montagnes*, of June 1864. The provisions of these laws, the experience gained in carrying them into effect, the attempts which have since been made to modify them in a retrograde manner, and the discussions regarding the practical advantage of these

Replanting of
barren hill
sides.

* The legislation on this subject should also be consulted. (Code des Dunes, 1801, 1810, 1817, 1862.)

measures, which are far from being closed, all this will be found highly instructive. Official reports concerning the progress of these operations have been published from time to time. With the guidance of these reports and of the advice of the Director and Professors of the Forest school at Nancy, it will not be difficult to frame a plan to visit some of the most instructive of these fields of operations. The system of barriers or embankments (barrages) across the ramifications of mountain torrents, which has been adopted with great success in the Alpine regions of France (*Département des Hautes-Alpes et des Basses-Alpes*) in connexion with planting and sowing, deserves special attention. Embrun, Gap, and Digne, are perhaps the best starting points for excursions to see what has been done in this respect. An excellent work on the formation and prevention of mountain torrents is *A. Surell, Étude sur les Torrents des Hautes Alpes, 1844.*

Timber sales.

In the State forests, and as a rule also in the communal, and even in many private forests in France, the timber is sold standing, the trees to be felled or to be reserved being marked by the forest officer or the agent of the proprietor, and the purchaser, upon whom the entire working devolves, is bound by stringent conditions of sale and under severe penalties to fell nothing but what has been sold to him, and to protect the reserved trees and the young growth from injury. Large periodical auction sales are held at the chief towns, when the standing produce of the next year's cuttings in the State and Communal forests of the district is sold to the highest approved bidder. These sales are generally held in autumn, and I would advise all forest officers who may be studying in France to make a point of being present at one of these sales. The conditions of sale (*Calier des charges and clauses spéciales*) should be studied, as well as the detailed list of lots to be sold, which states the number and description of trees, the area of the coppice, the limits of the cutting, the lines of export, and the outlay for the repair of roads, planting, pruning, and other improvements that will have to be borne by the purchaser. This system of selling the produce of entire cuttings standing, I am inclined to consider as one of the most remarkable features of forest management in France. A large class of timber merchants, who understand their business, and are generally men of substance, is the result of this system, which is in accordance with old custom, but has been steadily improved and developed. As far as my experience goes, the conditions of sale are strictly enforced, and the regeneration of the forests is not materially impaired by this mode of working them. Those who have served in the Forest Department of Burma will at once see the analogy which exists

between the permit system under which a portion of the Government forests in that province have for some time past been worked, and the system of timber sales in France, and to them it will be instructive to learn that it is possible so to frame the conditions of sale as to secure the conservancy and improvement of the forests, though the working may be in the hands of the purchaser.

The *Code Forestier* of May 1827, the history of the forest legislation which preceded it, and the additions subsequently made, deserve careful study. Forest officers studying in France will do well to make themselves acquainted with the practical working of the French forest laws, which I have no hesitation in saying are logical, efficient, and at the same time in a high degree considerate. I desire to draw special attention to the provisions of sections 3-6, which relate to the sales of forest produce, and without which it would not be possible to frame and enforce the conditions of sale as they are; also to section 8, on forest rights, under the operation of which the rights of wood and pasture, which formerly burdened the public forests, and greatly interfered with their economical management, are gradually being extinguished, being compensated by the grant of land or by money payments. Indian foresters will do well to make themselves familiar with the provisions of this section and with their practical application. Punishments of offences against the forest laws have, I understand, become comparatively rare in most parts of the country since the system of extrajudicial settlement of penalties and damages between forest officers and offenders has become generally authorised. These "*transactions avant jugement*" are now resorted to whenever possible, in order to prevent the case going into court. The offender is generally found ready to pay the amount fixed by the forest officer under the rules and regulations laid down for his guidance, in order to avoid appearance in court and the risk of heavier punishment. On the other hand the forest officer's time is saved, and what is worth more than all the rest, no ill feeling is roused by dealing with forest offences in this quiet business-like way. A better understanding is maintained between the population in the vicinity of the forests and the forest officers, while at the same time the prevention of offences is said to be as efficient as if every case were brought into court. The rules under which such "*transactions*" are authorised were issued in December 1859, and their working will be found instructive and suggestive in many respects.

Indian forest officers will be glad to make themselves acquainted with the exact nature of the regular work per-

The French forest law.

Work of a district forest officer in France.

formed by district forest officers in France. A small handbook by *Puton*, one of the professors at Nancy, "*Service administratif des Chefs de Cantonnement, Nancy, 1870*," will be found useful in this respect. Everything is arranged in a methodical and systematic manner down to the form of the note books (*calepins*) used in the operations of marking trees to be felled or reserved in a cutting, and revising the cuttings after the purchaser has completed his work.

The French Society of Foresters (*Société Forestière de France*) is an excellent private institution representing the special interests of forest property and encouraging the progress of silviculture in all its branches. Among its members will be found some of the largest forest proprietors, as well as some of the leading public forest officers. The meetings of this society are held at Paris from January to April. Foresters from abroad are admitted as visitors if introduced by members.

As regards the time of the year most suitable for studying forestry in France, I would suggest to commence early in spring, and to devote March to July to a number of forest districts in the manner indicated in the *Règlement*. The latter part of summer and autumn would then remain for the study of those special matters which have been mentioned in the present remarks. A residence at Nancy (but not during vacation time) should, under all circumstances, be included in the programme.

Those who desire to go through a course of professional studies in Germany should bear in mind that the administration of the public forests is different in the different States which compose the German Empire. Each country and province has its peculiarities, its strong and its weak points. A comparative study of forest legislation and forest management in the different German States would be highly instructive and suggestive for Indian forest officers, but this is a task which would demand perfect familiarity with the language and with the profession of forestry, and I would not recommend Indian foresters to undertake it. Here, as in France, it will be preferable to confine ourselves to the study in detail of a few forest districts, or rather portions of districts. The best guide in every instance will be found to be the working plan (*Wirtschaftsplan*). With its aid and the assistance of the district forest officer, it will not be found a difficult task to acquire a good knowledge of the present state of the forest, of its history, and of the projects and intentions regarding its future. A tracing of the working map (*Bestandeskarte, Wirtschaftskarte*) should be made, and with this and the needful extracts of the working plan in hand, one compartment after the other of the district

should be visited and examined. In the first instance I would advise to seek those compartments which contain forest of mature age growing under different circumstances of soil, elevation, and exposure, and to endeavour to form an idea of the number of stems per acre, their aggregate sectional area, the height of the forest, and the quantity of timber standing on an acre (or hectare). The mode of ascertaining the quantity of standing timber on a given area (Massenaufnahmen) and its annual increase, should be learnt and practised, as well as the methods for determining the normal annual yield of the forest. The next step would be to examine compartments of mature forest, where felling operations are to be commenced or are in course of progress. In these all that relates to the working of the timber and the regeneration of the forest, whether by self-sown seedlings or by planting, should be studied. Lastly, a series of compartments should be examined, representing the different ages of the forest growing under different conditions, from the young thicket to the nearly mature forest, and here special attention should be paid to the periodical thinnings. Should the district be composed of several working circles or classes of forest (Betriebsklasse, Betriebscomplex, Wirthschaftseinheit), then it will be necessary to go through each class in the same manner. The entire administration and management of the district should be studied—area, annual yield in material and money, the mode in which the operations of the year are regulated, the description of boundary marks, forest rights, roads and other means for the transport of timber, subordinate establishments, forest offences and mode of dealing with them, damage by storms, fire, or insects, sources of labour, prices of timber and other forest produce.

The thorough study of one forest district is, in my opinion, the first and indispensable step; this task cannot satisfactorily be accomplished under two months, and if possible a longer time should be devoted to it. A better foundation still would be laid if a similar course could be gone through successively in two or three forest districts presenting different features of soil, vegetation, and management. After completing this course, which stands in the place of a practical apprenticeship, the choice lies, in my opinion, between two plans, to visit a number of forest districts in other parts of Germany, or first to spend a term at one of the principal public forest schools, and then to travel, in order to see a greater variety of forest management. The latter course would require nine to ten months altogether, whereas the former could be accomplished in three to four months. The residence during a term at a forest school has many ad-

Importance of
visiting one
of the forest
schools.

vantages. By attending a few of the principal courses of lectures and all excursions, by reading and private instruction, according to a regular plan which the director of the institution will be glad to arrange, a more connected knowledge of the principal branches of forestry will be attained than can under ordinary circumstances be acquired by the residence at forest districts. The personal intercourse with the director and professors at the institution, and with some of the more advanced students, cannot fail to be instructive in many respects, and an advantage of some importance is the chance of meeting young forest officers from other countries, Russia, Sweden, Italy, Spain, who will often be found attending the institution for the same purpose. At the close of the summer-time, in August or September, most forest schools make an annual forest journey of two or three weeks' duration under the guidance of the Director. This affords an excellent opportunity for seeing a series of instructive forest districts under the most competent guidance, of taking part in important discussions on professional subjects, and of making the acquaintance of forest officers of all grades, in their divisions and forest districts. Such an opportunity should be utilised if possible. I feel assured that those who may follow my advice in this respect will not regret it, but will agree with me in valuing highly the advantage of having taken part in one of these forest journeys. In Captain Walker's report the names of the principal German forest schools are mentioned, and it is needless for me to say anything more on the subject.

Experimental
researches on
the growth of
forests.

Systematic experiments concerning the growth of forest vegetation and other matters connected with forestry have for some time past been instituted in Saxony, Prussia, and Bavaria, to a certain extent in connexion with the public forest schools of those countries. Thus, at Tharand, the durability of spruce timber felled in each month of the year, is now being tested, and at the same time the quantity of moisture, and the mechanical and physical qualities of timber felled in the different seasons is being determined. Again, there is a physiological laboratory at Tharand, where plants of different kinds are grown in water under the influence of various soluble substances, and these experiments have already yielded important results. In several forest districts plots of young forest have been fenced in, and are subjected each to a different treatment. In Bavaria extensive meteorological observations are being made, in order to determine the climatic requirements of the different forest trees, the influence of forests upon climate, upon

the temperature and moisture of the soil, and upon the formation of springs. In the Spessart systematic experiments have been commenced, in order to determine the effect of different systems of thinning, early and late, slight and strong, upon the annual production of wood on a given area; and besides these there are numerous other questions which it is contemplated to subject to a regular series of systematic experiments.

Instead of recommending any particular forest districts, I will rather mention the principal classes of forest which should, as far as possible, be studied in detail. Of coppice woods, the oak coppice of western Germany, the Rhine, Moselle, and the Odenwald should be examined. Their management (generally on a rotation of 14 to 16 years) is simple, nevertheless much skill and thought has been brought to bear upon them. Of high timber forests I will first mention those of oak and beech mixed, which may be seen to perfection in the province of Hanover and in the Spessart hills in Franconia; they are maintained by self-sown seedlings, with the aid, particularly as regards the oak, of sowing and planting. The various means by which the development of the oak is favoured at the expense of the beech, but at the same time with its aid, should be noticed. On the Spessart special attention is invited to the difference between the central forest tracts, where the ground has always been under cover, and the outskirts, where the land has been so impoverished by pasture, the removal of dead leaves, and wasteful fellings, that it has become necessary to improve these tracts by extensive plantations of coniferous trees. The soil overlying the red sandstone of the Spessart is by no means rich in itself, it has however been improved by the accumulation of vegetable mould during ages of forest growth, and the results are these splendid pieces of sound oak timber, 60 feet long and more, with a diameter of 2 to 3 feet at the smaller end, which are produced in the Rothenbuch and other districts. The different requirements and mode of growth of the oak and beech will be found to be one of the most instructive features in this class of forests, and those cases where there are other trees, besides, such as maple, lime, and ash (the vicinity of Göttingen and Lauterberg on the Harz) should be studied with special attention. The oak and the ash will be found to possess certain points in common with the teak tree. Pure oak forests (generally of *Quercus pedunculata*) will be found on deep alluvial soil along the Elbe and other rivers. The rapid growth of the oak on rich soil should be noticed, and the high prices realised by its timber, not less and often

Classes of
forest recom-
mended for
study.

more than the close grained and slowly-grown timber of the Spessart.

Scotch fir
forests.

In the plains of north-east Germany, Hanover, Brandenburg, Saxony, the extensive Scotch fir forests, which are mainly regenerated by sowing and planting, should be visited. Insects have been the great difficulty in many of these tracts, and in some cases an attempt has been made to revert to natural regeneration on that account. In the eastern provinces of Prussia forest fires have also been most destructive. The Scotch fir forests of Franconia (*Steigerwald*, *Hauptsmoor*, near *Bamberg*) are principally maintained by self-sown seedlings. In these forests the successful employment of an underwood of beech to improve the growth of the Scotch fir should be noticed. In the forest tracts round Kloster Ebrach will be seen the results of this system in the shape of magnificent stems, with dark red heartwood, which fetches a higher price than oak. A different sort of management may be studied in the sandy alluvial plains of Hesse-Darmstadt. The Forest crop (Scotch fir, and sometimes oak) is made to alternate with cereal crops. This remarkable system should be studied in the Grand Ducal Forest District of Viernheim, where it is in force on an area of 5,000 acres. The forest crop is cleared and rooted up, and the ground is then planted in lines with Scotch fir, on better soil mixed with oak (the Scotch firs acting as nurses to the oak), and potatoes are planted between the lines. The second year a crop of rye, and then two more crops of potatoes and rye are taken. In this manner the young plants are sheltered during the first four years of their existence, and the ground is kept clear of grass. Under the peculiar circumstances of the locality, deep but moist sand, much exposed to late frosts in spring, this system answers admirably, the growth of the trees is better than where no crops are taken off the ground (in the vicinity), and in addition there is a surplus from the agricultural part of the operations. Forest officers from Burma will be glad to see this system, which is analogous to what was introduced in 1864 in the teak plantations near Toungoo.

Spruce and
silver fir.

Of other coniferous forests I will note specially the splendid spruce forests of the Harz, the Thüringer Wald, and Saxony, mixed here and there with Scotch and silver fir, and mostly regenerated by planting, and the silver fir and spruce forests of the Schwarzwald, in the kingdom of Wurtemberg and the Grand Duchy of Baden, mainly regenerated by self-sown seedlings. The great variety in the rocks and soils of this most instructive mountain range should be noticed. *Gneiss* prevails in the centre on the

west side, and is surrounded on three sides, viz., north, west, and south, by an irregular belt of *granite*, and these crystalline rocks are overlaid nearly all round by strata of *red sandstone*, so that in many places, for instance near Rippoldsau, the lower slopes of the valleys consist of *gneiss* or *granite*, while the ridges, spurs, and the high table land between the valleys are composed of *sandstone*. Further east, towards the Valley of the Neckar, *mäschelkalk* overlies the *red sandstone*. The comparative study of forest vegetation on those different descriptions of soil will be found most instructive. Three distinct systems of management may be studied on the Schwarzwald, each of which has its peculiar advantages according to the circumstances of the forest. In the Wurtemberg State forests the mature crop is removed by a regular series of successive cuttings, extending over a period of from 10 to 15 years, planting being resorted to whenever necessary. The result of this system is a strictly regular gradation of ages, and no forester will visit the districts in the vicinity of Freudenstadt, for instance, the magnificent forest of *Pfalzgrafenweiler*, without admiring the complete and uniform masses of all ages, from the youngest growth to the gigantic stems which this district produces. A different system is followed in many of the Baden State forests, and in a great portion of the forests on the estates of the Prince of Furstenberg. Here also the mature crop is removed by successive cuttings, but they extend over a much longer period, frequently from 30 to 40 years. The heavier and older timber which is not likely to increase much in value is taken out first, meanwhile the ground gets covered with young growth, mixed with groups of old timber, but still in full vigour; which having got sufficient side room, are increasing rapidly, and when these have attained good marketable dimensions, then they also are cut out successively, so that when the last of the old crop falls, a portion of the young forest has attained a considerable size. The result of this system is necessarily a forest of somewhat less regular character, but it is compact, and the inequality of age which is marked in the young growth gets much less conspicuous as the forest grows older. The third system consists in cutting out the oldest and heaviest timber from all parts of the forest, one compartment after the other being worked in regular rotation. This system (*Femal*, or *Plänterhieb*) is the only safe plan on steep slopes or on rocky ground, where the main object is to keep the ground covered as much as possible, and never to allow a blank, where the soil might get loosened and ravines or torrents formed. Cutting by selection is also the prevailing

system in many of the smaller private and communal forests of the Schwarzwald, and something intermediate between this and the second system is found in the large private forests in the Valley of the Murg near Gernsbach (Schifferswaldungen).

Different
systems of
management in
the Black
Forest.

The study of the comparative merits of these three systems will be found highly instructive, and discussions on this subject with the local forest officers will be found most interesting. The effect of storms upon compact masses where the trees have drawn each other up to great lengths, after cutting has commenced, is often extremely destructive, though less so with the silver fir than with the spruce, and experience has shown that forests of a more irregular character, where the old timber has grown up in isolated groups, have greater powers of resistance against wind and storms. On the other hand the irregular system has many drawbacks. Where the ages are well separated in different compartments, pasture can be permitted without any injury to the forest in the older blocks, but under the irregular system cattle must either be excluded entirely, or the young growth must suffer. It would lead too far were I here to enter fully into the merits of these different systems. They must be studied on the spot, with the aid of the working plan and of the statistical data showing the results of the working of each system in different forest districts.

Forest legis-
lation in Wur-
temberg and
Baden.

Those who have time should, while in the Black Forest, make themselves acquainted with the difference in forest legislation and organisation of the forest service in both countries. The kingdom of Wurtemberg has no separate forest law, Baden on the other hand has a most elaborate, and as far as I am able to judge, efficient forest legislation. Special attention should be directed to the provisions which regulate the supervision of private forests, contained in the general forest law of 1833, and modified by the special law of 1854. In this respect forest legislation has in Baden gone further than in most other countries, and some of the provisions are almost as stringent as those of the forest law of the *Canton de Vaud* in Switzerland. Thus no forest can be rooted up without the sanction of the forest department, and no clearing is permitted without sufficient guarantee that the forest will be restocked, and if not restocked within a certain period, the work may be done by the forest department at the proprietor's expense. In the case of small detached forest property the guards who have the protection of the forest are appointed by the village community to which they belong, and their appointment requires the confirmation of the chief civil officer of the

district. These are only a few provisions of a law which deserves careful study, the more so, as it is in force in a country which has for a long series of years enjoyed truly liberal institutions.

In the matter of forest administration it should be noticed that in Baden there is at Carlsruhe, the seat of the Grand Ducal Government, a board of councillors, presided over by a director, for the management of forests and other public domains. This board or council is subordinate to the minister of home affairs and the finance minister, to each in his own branch, but it has its own defined limits of authority, special matters only being referred to the ministry. Between this body and the district forest officer there is no intermediate authority; each district, however, is inspected periodically by one of the forest councillors. The entire country is divided into 110 forest districts, and most district forest officers have thus the supervision of communal and private woodlands in addition to the State forests under their charge. The question whether any land comes under the head of forest is settled once for all by the entry in the *Cataster* register. In Wurtemberg local inspecting officers, each in his division, are placed between the district forest officer and the central authority at Stuttgart. A remarkable institution of that country are the military forest guards. Non-commissioned officers are, as reward of good conduct, appointed forest guards (*Forst Wächter*), without, however, ceasing to belong to the military establishments. Each forest guard has charge of a subdivision of the district, he is employed to protect the forest and generally to assist the district forest officer in his subdivision, but in all matters of discipline he is subordinate to a superior military officer at Stuttgart, who is member of the Central Board (*Forst direction*).

Forest administration in Wurtemberg and Baden.

Regarding the transport of wood and timber, and the impregnation of timber, the following remarks may be found acceptable; they are an extract of a report which I drew up on the subject in July 1872. In this respect also the Black Forest is one of the most instructive forest regions. The country is hilly, difficult, and large quantities of long and heavy logs are exported from it annually. The floating of timber has gradually diminished with the increase of railways, but on the rivers Kinzig and Nagold, and their tributaries, large timber is still floated to a considerable extent, and under arrangements which are extremely instructive. March and April are the best months to study the floating on these small rivulets,* the peculiarity being,

Working of the forests.

* Floating, however, often takes place during summer also.

that by storing up water in tanks and reservoirs, an artificial flood is produced which floats down the long narrow rafts, several hundred yards long, though the flood itself is not more than about twice the length of the raft. I do not know of any forest district in India where the same arrangements could be made; but circumstances regarding the carriage of timber are never the same in any two places. People who have studied the transport of timber in Europe will, when brought to India, see that they have only learnt how difficulties of a similar nature have been overcome under circumstances widely different.

Land transport
in the Black
Forest.

Three points are of special importance here in the land transport; first, the moving of the heavy logs down to the nearest road or slide; secondly, the construction of timber roads; thirdly, the use of these roads and of other lines as timber slides. In the Black Forest all fellings, as a rule, take place in summer, and the timber is being brought to the roads until autumn; but the construction of slides and the sliding down takes place in October and November. The locality most conveniently situated to study these matters is Rippoldsau, a small watering place situated in the midst of the well known forest belonging to the Prince of Fürstenberg, which is surrounded by other instructive forests belonging to Baden and Wurtemberg, partly State, partly communal forests. The system of timber roads in the Rippoldsau district is admirable. To study the system of land and water transport employed in the different forest districts of the Black Forest, it would be necessary to devote part of August, September, October, and November to it, and to visit during that time the following places, Rippoldsau, the valley of the Murg, St. Blasien in Baden, Freudenstadt, and Wildbad, in Wurtemberg. I do not know of any forests so extensive as the Black Forest where the moving of long and heavy timber over difficult ground by means of simple appliances is done in a manner equally efficient, economical, and with the same care for the young growth of the forest.

Wood
transport in
Bavaria.

In Bavaria two extensive forest tracts are specially important for the transport of timber. In the "Baierische Wald," which covers the hills north of the Danube between Passau and Regensburg, the arrangements made to facilitate the floating on the rivers Ilz and Regen and their tributaries are worth studying, and in the eastern Bavarian Alps (Salinenbezirk) both the land and water carriage of the wood required to feed the saltworks of Berchtesgaden, Reichenhall, Traunstein and Rosenheim is instructive. July and August are, I believe, the best months for these dis-

tracts. However, there is this drawback, that a small proportion only of the wood is timber; most of it consists of small pieces for burning. Nevertheless, a great deal that is suggestive for our Himalayan forests may be learnt in the Bavarian Alps.

In Austria, the most instructive arrangements for the transport of wood with which I am personally acquainted are those made to provide the large quicksilver works of Idria with wood for fuel. I visited them in 1865, and forest officers who have time to spare during their leave will do well to devote a week to their study. Idria is about 30 miles distant from Loitsch, the nearest station on the Trieste-Laibach railway. The wood is carried on temporary tramways, which are built with great care over most difficult ground, whenever fellings commence in any forest tract; and which are broken up, and the timbers which form the roadway and viaduct sent down, after they have served the purpose of carrying the yield of the forest tract felled to one of the small streams down which the wood is floated to the works. The dams and spurs constructed for storing up water in these streams, and for regulating their course, are as instructive as the system of these temporary timber tramways.

In the Italian (formerly Austrian) Alps north of Venice, Friaul, the carriage of timber (not of firewood) offers much that is interesting and suggestive to Indian forest officers. The forests are the property of the Communes (towns and villages) in the valleys of the rivers Piave and Tagliamento and their feeders. The timber which is yielded by these forests is shipped at Trieste and Venice, and is an important source of supply for the countries in the eastern part of the Mediterranean. I visited these forests in 1865, and found that the lumberers of Friaul were extremely skilful in managing the land and water transport of their timber under exceedingly difficult circumstances. Temporary timber slides similar to the tramways of Idria, are built down the hill slopes, or on timber viaducts across ravines, and as the operations in one locality are completed, the timber composing these structures is sent down after the rest. Under Austrian rule, these forests were under efficient supervision, which was exercised by the Officers of the State Forest Department, and in consequence they yielded a steady annual revenue, from which the communities in those valleys built churches, school-houses, town-halls, and constructed a system of admirable roads. I have rarely been struck more forcibly by the beneficial effects of well managed communal property, upon the well-being of the population of small towns

and villages than in this instance, and on this account also a visit to these forests by Indian Forest Officers would be useful.

Tools used.

One of the main points to which the attention of Forest Officers visiting the localities mentioned should be directed is the use of the different sorts of levers and other tools which the lumberers employ. Some of these tools may merit imitation in India. The pick-lever (Krempe, Sapine) is one of the most important, and the different forms of it which are used in the Schwarzwald, the Bavarian Alps, Idria, and Friaul, should be carefully noted.

Impregnation
of timber.

I now proceed to offer some suggestions regarding the study of the impregnation of timber. Of the numerous methods that have at various times been tried, there are, in my opinion, only two which are likely to meet our requirements in the Indian forests. The first is known as Boucherie's system. Timber, fresh felled, not dry, is impregnated with a solution of sulphate of copper, under a certain amount of hydrostatic pressure, the tanks being raised about 30 feet above the pieces to be impregnated. This method has been found to answer best for the impregnation of telegraph posts, and is largely used for that purpose in France and Austria. For various reasons, mainly because our forests are scattered over a large extent of country, and not sufficiently compact, this method does not appear to be as suitable in India as the following. The second is impregnation in air-tight cylinders. The wood, which is ready cut (sleepers, posts, planks, or other scantling), is dried completely, and then placed in the cylinders, which are first evacuated, so as to diminish the resistance which the air in the pores (tubes and vessels) would offer, after which the fluid is admitted, and forced into the wood under considerable pressure. The principal kinds of antiseptic fluids employed under this system are,—*creosote* (obtained by the distillation of coal tar), *chloride of zinc*, and *sulphate of copper*. Besides these substances, *corrosive sublimate* is used on some of the German railways (Nassau and Baden).

Antiseptic
substances used.

Boucherie's process must be learnt in France or Austria, but the pneumatic process for creosote may be studied quite as well in England. Pneumatic apparatus for the impregnation of beams, railway sleepers, and other scantling with creosote are numerous. On the Continent, I may mention the following establishments, which are well worth seeing:—

Creosote.—Rheinische Eisenbahn, Nippes, near Cologne. I visited this establishment last year, and found the arrangements excellent, and most instructive.

Chloride of zinc.—Brunswic and Hildesheim, near Hanover.

I do not know these establishments myself, but understand that they are well worth a visit.

Sulphate of copper is still used in pneumatic apparatus (cylinders of copper) on some of the North German lines, but I have not yet been able to ascertain particulars regarding existing establishments. In 1865 it was also in use on the North Italian lines, the impregnating apparatus being at Verona.

Corrosive sublimate is used at the impregnating establishment of the Nassau lines at Limburg, not far from Coblenz. I regret that I have not had an opportunity of visiting this establishment, and I am not acquainted with the apparatus employed, but I have lately seen a report regarding the duration of sleepers impregnated with that substance on the Nassau lines, which appeared to be favourable.

In 1871 the following antiseptic substances were used by the lines of the Association of German Railways:—

Chloride of zinc on	-	-	22 lines.
Sulphate of copper on	-	-	19 "
Creosote on	-	-	15 "
Corrosive sublimate on	-	-	14 "

In England creosote is the substance mainly used for the impregnation of railway sleepers.

It may not be useless in conclusion to give a list of a few German books and periodicals on Forestry, which will be found useful. Of the periodicals, which are numerous, I will only mention *Heyer, Allgemeine Forst und Jagdzeitung* (monthly); *Tharander Forstliches Jahrbuch* (quarterly); *Baur, Monatschrift für das Forst- und Jagdwesen* (monthly); *Dawchelmann Jahrbuch der Preussischen Forst- und Jagdgesetzgebung und Verwaltung* (annually). The proceedings at the periodical meetings of the general and local associations of foresters in Germany contain much that will be found instructive, and should officers find time to attend any of these meetings, they will not regret having done so.

German forest literature.

As a general handbook I am inclined to name *Carl Fischbach, Lehrbuch der Forstwissenschaft*; for forest culture, *Burckhardt Saen und Pflanzen*; for plans of operations, *Judeich Die Forsteinrichtung*. For timber transport and working of forests the following: *Gayer, Forstbenutzung*, 2nd edition, *Aschaffenburg*, 1868. *Forstliche Mittheilungen des Königl. Baierischen Ministerial Forst Bureau Band III. Heft 2, München*, 1860. (Contains: *Artikel über Holz aufbereitung und Landtransport*.) *Buresch, Darstellung der verschiedenen Verfahrensarten und Apparate welche zum Imprägniren des Holzes Anwendung gefunden haben*. *Dresden*, 1860: Regarding forest legislation, *Roth, Handbuch des*

Forstrechts (with special reference to Bavaria). *Pfeil, Anleitung zur Ablösung der Wald-Servituten*. Regarding forest statistics, *Leo, Forststatistik über Deutschland und Oesterreich-Ungarn*. A small spirited book by August Bernhardt, on the general question of the maintenance of forests, *Die Waldwirthschaft und der Waldschutz*, will be read with interest. *Die Forstverwaltung Bayerns* and *O. von Hagen, Die forstlichen Verhältnisse Preussens* are works of permanent value, which may serve as a model for similar publications in India.

Forest ad-
ministration
in Italy.

In conclusion I desire to draw attention to the recent development of forest matters in Italy. Shortly after the establishment of the present kingdom a central forest school was organised in the vicinity of Florence. The director is A. di Béranger, formerly in the Austrian forest service of Venezia, and well known by his excellent work on the history of Forest management in Italy (*Archeologia Forestale, ossia dell' antica Storia e Giurisprudenza Forestale in Italia. Venezia, 1863*). The district assigned to the institution is the splendid silver fir forest of Vallombrosa, below the crest of the Apennines, on their western slope, about 20 miles east of Florence. During winter the school is transferred to a lower situation at Paterno, in the region of the Olive, half-way between Vallombrosa and the railway station of Pontassieve, in the valley of the Arno. A visit to Vallombrosa will be found pleasant and instructive, and forest officers who may come home from or return to India viâ Italy, will be glad thus to see something of forestry in that country. For the use of the students a collection of excellent memoirs* is being published by the director with the assistance of some of the professors, the first volume of which has just been completed containing an introduction on the climatic and general influence of forests, a brief historical account of Forest management in Germany, France, and Italy; two memoirs on the structure, nutrition, and cultivation of forest trees; and a paper on the valuation of forests and the preparation of working plans. This publication is to appear periodically in the form of a forest journal, and the first volume contains, besides the larger papers mentioned, various short notices on matters relating to forestry. Italian forest literature otherwise is not rich, but of late there has been a series of important and interesting official publications by the Ministry of Agriculture, which is entrusted with the direction of forest administration in Italy. The two most important of these are a collection of the laws and statutes relating to forests

* Raccolta di Memorie lette nel R. Istituto Forestale di Vallombrosa.

which have legal force in the different territories composing the kingdom, and a general statistical account of forest lands in Italy.* Of the last-named work the introductory part has been separately published in the Annals of the Ministry of Agriculture. Of a total area of $28\frac{1}{2}$ million of hectares, inhabited by a population of $24\frac{1}{4}$ millions, five millions of hectares was in 1870 classed as forest land, made up as follows:—

State forests	-	-	194,000 hectares.
Communal forests	-	-	2,170,000 „
Private forests	-	-	2,662,000 „
Total			<u>5,026,000 hectares.</u>

The large ecclesiastical estates which of late years have become public property, have not been retained as State forest, but have been sold, and a considerable portion of the Crown forest lands and other dominions of the different Italian territories, has also been alienated. This explains the small extent of State forests in the present Kingdom of Italy. The question of the forest lands in the Island of Sardinia, which are, or were until lately, the joint property of the State and communes, has not yet, I believe been finally settled, and to the extent of half a million of hectares they are entered under the head of communal forest lands.

Projects of a general forest law for the whole kingdom have repeatedly been submitted to the Italian Parliament. The evil effects of denudation are keenly felt in many parts of the country, and the aim of these proposed legislative enactments has hitherto been to guard against further mischief, by determining beforehand which lands shall, in the public interest, be clothed with forest or be kept under forest, and then to place the whole of these lands under the supervision or control of the public forest officers without distinction, whether they happen to be the property of the State, of village and other communities, or of private persons. From the report with which the Minister of Agriculture submitted a project of general forest law, in March 1870, it appears that the financial exigencies of the country had rendered imperative the alienation of the greater part of the forests at the disposal of the State, and that it was only intended to retain a limited area of State forests, mainly with the view of supplying the timber required by the Navy, and the forests required for this purpose the bill proposed to declare inalienable.

Projects of
general forest
legislation.

* *Raccolta delle Leggi Forestali*, 1866. *Statistica Forestale*, 1870. Some of the figures in the latter work are believed to be open to correction.

Thus, with regard to forest matters, it seems probable that Italy will pursue a policy different from that which has of late years been initiated in most provinces of India. In those provinces we acknowledge the necessity of maintaining certain areas under forest, or of clothing them with forest when they are bare, but we do not expect any satisfactory success in these attempts, unless the forests to be thus maintained or created are under the entire control of the State, and we entertain no serious hopes of effecting any real good by the supervision of private forests, or by any general kind of control over communal forests, unless the administration or management of such communal forests can be vested entirely in the hands of the public forest officers.

The general forest policy of Italy compared with that pursued in the provinces under the Government of India.

In those provinces, therefore, of the Indian Empire, to which I now refer, our principal aim is in the first instance to consolidate the State forests wherever the State has suitable forest land at its disposal, and we hope that eventually, when the majority of public forest officers shall have acquired that professional knowledge, skill, and experience which is necessary for a satisfactory management of forest lands, that they may be found competent, not only to manage the State forests entrusted to their charge, but also to induce large landed proprietors to follow their example in the management of their own estates, and if such should ever be found necessary and expedient to exercise an efficient supervision over private and communal forest lands; but we think that any attempt to exercise supervision and control over private and communal forest lands through the agency of forest officers who have not actually charge of public forests entirely under their control, and who cannot point to the management of their own forests as an example to be followed in the management of the private or communal forests, would lead to unsatisfactory results. The further development of the general forest policy in Italy will doubtless be followed with great interest by Indian foresters, and on this account it appeared to me right to add the present remarks.

The old State forests of the Venetian Republic

Besides the silver fir forest of Vallombrosa there are many other public forests of interest in Italy. A mere enumeration would be of little use, and a descriptive account would lead too far; it must suffice to state that any forest officers who may visit the communal forests of Friaul will do well to see some of the old forests of the Venetian republic, which in the middle ages and during the centuries immediately following, yielded a large portion of the timber required for the navy of that rich and powerful State. The oak forest of Montello, near Treviso, the mixed beech and silver fir forest of Cansiglio on the limestone hills, north of

Ceneda, are some of the old State forests of Venice, and the boundary marks of the republic cut in the live rock were shown to me eight years ago on the south-east limit of the Cansiglio forest. High up on a tributary of the Piave, near the small town of Auronzo, is the Sommadida forest, of limited extent, but on deep rich soil, and with exceedingly luxuriant growth of spruce, larch, and other trees. The larch is here in its native home, and I have never seen finer specimens, both as regards length of stem and quality of the wood. The mast pieces for the Venetian Navy were partly brought from this forest. I understand that it is not intended to alienate Sommadida, which I fear may be the case with many of the other old Venetian State forests. Mast pieces for the dockyard at Venice, however, were in 1865 brought at less cost by rail from the forests of Galicia than down the Piave from Sommadida. Such has been the effect of railways upon timber trade. The wine casks for Hock and Moselle are no longer exclusively made of oak from the Spessart or the forests near the Rhine, for the oak imported by rail from Hungary and Dalmatia at present undersells the home grown timber, and similar changes and fluctuations will from time to time be experienced in India. So much, however, is certain, that the demand in India for timber, bamboos, wood, fuel, and charcoal, whether for export, for building, or for the use of steamers, railways, or ironworks, is not likely to decrease, but is certain to increase steadily. Nor is the law that an increased demand will always produce an increased supply, likely to hold good in the case of a timber crop, which requires 100 years or more to attain maturity. The formation and consolidation of public forests, therefore, managed by State forest officers, which has for some time been progressing in most provinces against much opposition, will eventually be recognised as a source of prosperity and comfort by the manufacturing, trading, and agricultural population of India.

D. BRANDIS.

NOTES.

p. 166. *Forest Management in Switzerland*.—Forest officers, who have had the privilege of serving in the Himalaya will find much of special interest in the Swiss Alps. The system of management in the Bavarian Alps, it is true, is more perfect throughout, but in Switzerland the difficulties in the way of forest conservancy have been much greater, and offer many points of analogy with those obstacles which impede progress in our Himalayan forests. There is no lack of forest rules and